Becoming a Fisheries Biologist: Sizing Windowpane Flounder in the Atlantic

Subject (Focus/Topic): Fisheries Biology

Grade Level: 6-8

Average Learning Time: two sessions of 45 minutes

Lesson Summary (Overview/Purpose):

For students to get the opportunity to become a fisheries biologist and look at the process of taking fisheries data and the type of analysis that a fisheries biologist would do.

Overall Concept (Big Idea/Essential Question):

- Students will understand how fish are measured aboard the *Henry B. Bigelow*
- Students will understand the importance of sampling fish
- Students will learn how to measure fish in a similar fashion to those aboard the *Henry B. Bigelow*
- Students will gain greater understanding of the kind of analysis that fisheries biologists use to inform them on the health of fish stocks

Specific Concepts (Key Concepts):

- How to measure fish
- Why measuring fish is important to monitor fish stocks
- How scientists analyze the data they collect to monitor fish stocks

Focus Questions:

- Why does the National Oceanic and Atmospheric Administration (NOAA) Fisheries ship, *Henry B. Bigelow* sample fish with trawl nets in the Fall and the Spring?
- What do the scientists do with the fish that they catch and why?
- How do you measure a fish? More specifically how to you measure windowpane flounder?
- What kind of information can biologists attain from this data collected by NOAA?

Objectives/Learning Goals:

- Students will use photos of 33 windowpane flounder and measure the length

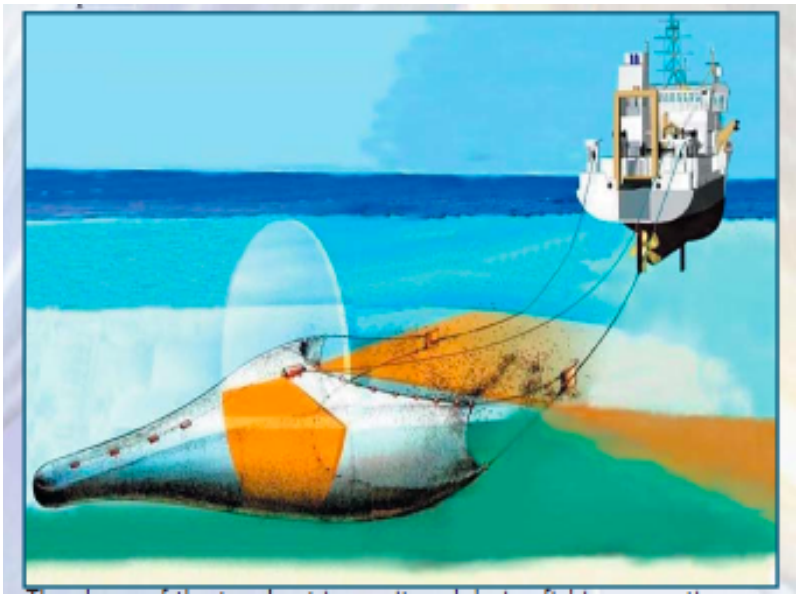
using the computer program Image J.

- Students will be able to use the measure tool on Image J to record length of fish
- Students will be able to use the NOAA Northeast Fisheries Service website to quantify how old each windowpane flounder is and record on paper or in Microsoft Excel
- Students will be able to sort fish by their age and create a histogram to represent how many fish are in each age group
- Students will understand the factors that go into aging fish and the importance of knowing the age of fish
- Students will gain an understanding of the measurements and science that goes into aging fish

Background Information:

The Northeast Fisheries Science Center, part of the NOAA's Fisheries Service, is responsible for research and assessment of marine resources. The aim of the program is to promote the recovery of depleted stocks and provide the research to promote the sustainability of marine stocks for economic benefits of their use. Research is concentrated on the Northeast Shelf of the United States. The scientific goals of the program is to establish a baseline data for the long term monitoring of the status of marine resources while using an ecosystem approach to provide advice to those that manage marine resources.

Cruises up and down the Northeast Shelf take place in spring and fall. *The Henry B. Bigelow* is one of the ships that participate in this research.



Photograph shows Benthic Trawls that are done at a number of stations up and down the eastern seaboard. Noaa.gov

At each station the benthic trawl net is deployed and once it has hit the bottom is towed behind the ship for twenty minutes. All of the catch is hauled back in the net and moved to a checker that is connected to a conveyor system. Scientists sort all of the fish and invertebrates by species. Depending on what species it is, the Fisheries Scientific Computer System (FSCS) will tell the scientists what measurements to make and other data to collect from a given organism.

The species that the students are going to become familiar with is the windowpane flounder, *Scophthalmus aquosus*. This is a commercially important species of flatfish that may be found between the northwest Atlantic between the Gulf of St. Lawrence and Florida. Their habitat is sandy bottom and they can be found in bays all the way out to 60 meters of water. Students will be looking at the stock of Windowpane flounder of Southern New England/middle Atlantic. These two stocks are currently managed separately.

Students should understand that the data found on the website to use length data to predict age is also a product of looking at fish ear bones (otoliths) and scales. From looking at scales and otoliths, scientists can understand what "year class" a fish is in. This allows them to correspond their lengths with the year class that that particular fish falls into. With the length data they will collect in this lesson and the otolith data provided by the Northeast Fisheries Science Center, students can take this data to make a frequency table of the number of individuals in each age class for this particular set of fish. Data is also collected for these models through fisheries observers aboard commercial fishing vessels.

Common Misconceptions/Preconceptions:

The set of pictures is NOT an entire population, therefore we cannot make a conclusion about the entire population.

Materials:

Graphing paper and pencils

Technical Requirements:

Projector, access to computer with freeware "Image J", Microsoft Excel (Optional), internet access

Teacher Preparation:

- Teachers will familiarize themselves with the freeware Image J.
- They will be able to effectively demonstrate how to use the ruler tool on Image J to measure the windowpane flounder. They will also be able to "set the scale" and demonstrate this effectively.

- Teachers will review the answer key (though numbers will vary based on precision of students!)
- Teachers will be prepared to move from the graph to discussions about how fisheries biologists use this data.

Helpful Links:
NOAA Teacher at Sea Blog
http://teacheratsea.wordpress.com/category/kaitlin-baird/

Review of the species: Windowpane Flounder
http://www.nefsc.noaa.gov/sos/spsyn/fldrs/window/

Keywords:

Otolith- The inner ear bones found in many organisms. In fish, they are located in the head and are made up of calcium carbonate crystals. A fish uses these bones for balance, detection of sound and to orient themselves in the water column.

Histogram- A way to graphically represent data in a visual fashion to show how data is distributed within categories.

Fish Stock- means a group of fish of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature.

Overfishing- When a fish stock is being fished at a fishing mortality rate that exceeds the overfishing threshold set by the National Marine Fisheries Service.

Pre-assessment Strategy:

To get an idea of how much students are able to grasp about the topic of overfishing and understand a good preassesment would be an assignment to write a story for a 8-10 year old about what overfishing is and why it's something that scientists look at. This will give the teacher a window as to where they are at in terms of their understanding of the topic and a fun way for them to be creative. They can be able to use a medium of a picture book, cartoon; blabberize.com etc to choose what best fits them. This would not be a graded assignment but a fun way to introduce the topic.

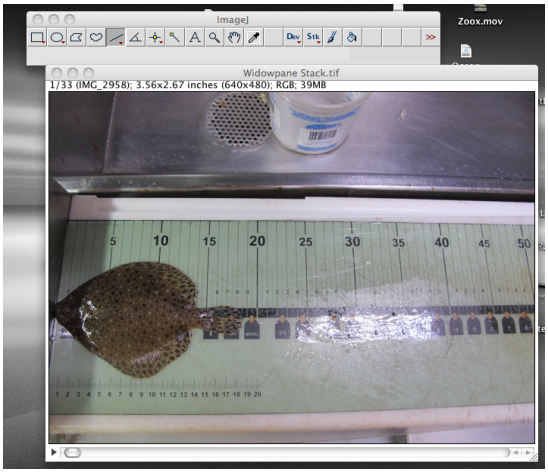
Anticipatory Set:

Have you ever wondered how fishermen know how many fish they can catch each time their boat goes out? Scientists are constantly surveying and studying our fish to see how many are out there and how old they are. From this information fisheries biologists can get an idea of how healthy a particular fish stock is. This information is given to scientists who forecast or predict based on many inputs how a fish stock is

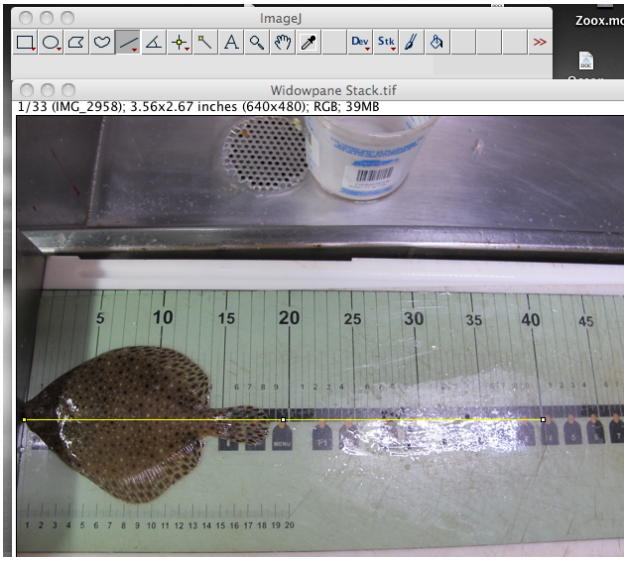
going to fair in years to come. This allows for a catch quota to be given to fishermen for each season. The goal of all the research on the fish is to allow species to persist sustainably for years to come. Today, you are going to become a fisheries biologist and gather the data for the modelers on the age structure of this subset of windowpane flounder.

Lesson Procedure:

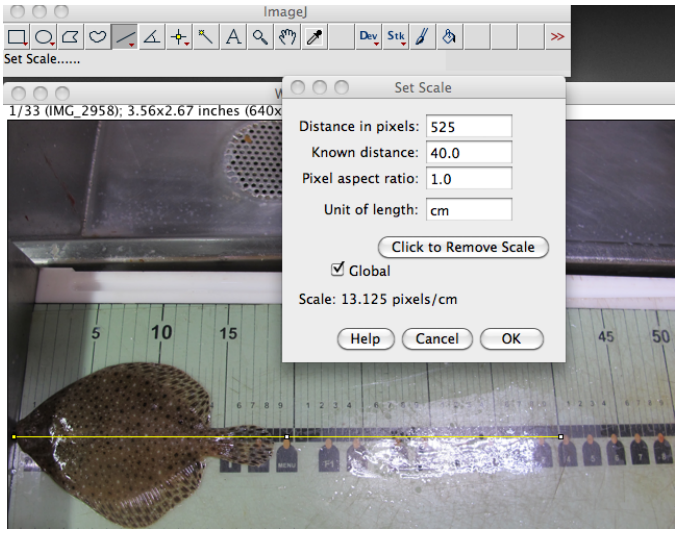
A. After opening Image J on your computer go to
   File-→ Open and open the file labeled (Windowpane Stack.tiff)
   This file is provided alongside this lesson as downloadable file
   This file contains 33 photos of windowpane flounder all in one frame
B. The first thing you will have to do is click on the line Icon shown in the sceenshot below 



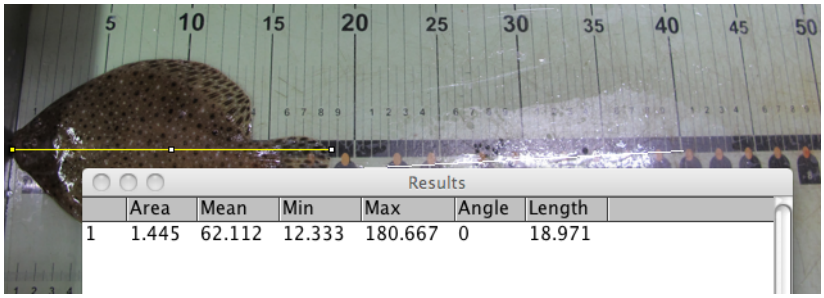
C. Take this tool and draw a line from the start of the ruler on the board to 40 cm this is going to be our "known measurement" and will allow us to **Set the Scale.**



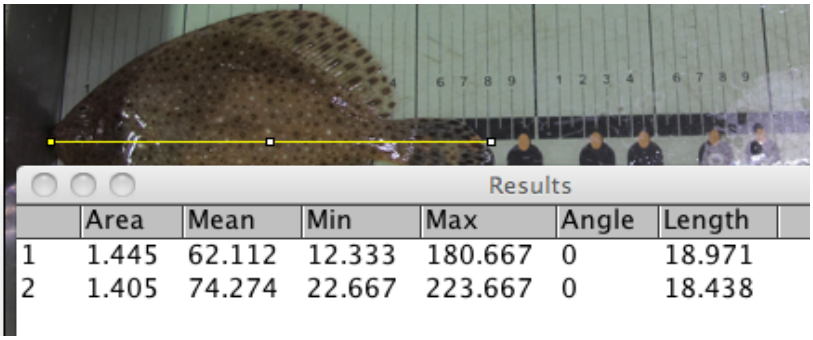
D. To set the scale now that you have your known distance select **Analyze** on your toolbar and **Set Scale.** This will give you a window like the one below. The computer has the known amount of pixels in the box to now equate with your know distance of **40 cm.** You will add in all of this information demonstrated in the photo below. Select **Global** in this window and this will save the scale for all 33 photos.



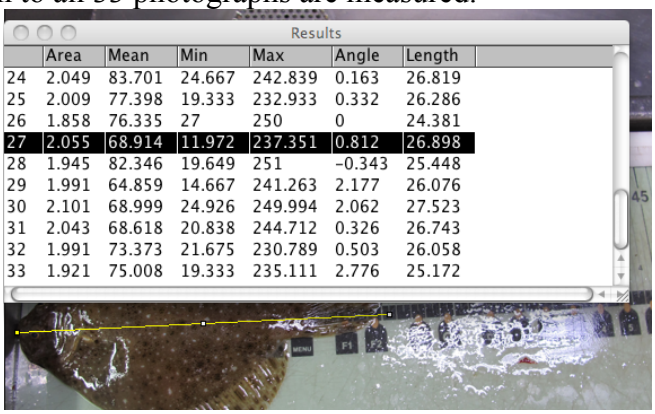
E. Now that the scale is set you can measure your first fish by taking your tool and going from the mouth of the fish to the tip of its tail. You can then go to the toolbar and select **Analyze-→ Measure** (or control+m/Apple m).



F. The field of interest will be the length (eg for this fish: 18.971)
G. Move on to fish #2 by using the scroll bar at the bottom of the photo. The scale should remain the same. It won't however if you did not select the **Global** in the **Set Scale** function and will have to re-set it.



H. Continue on to all 33 photographs are measured.



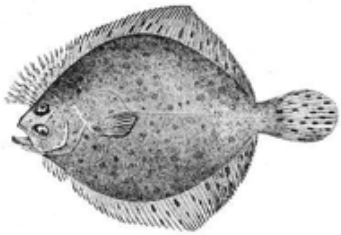
H. Once all 33 fish have been measured it can be highlighted and copied to a Microsoft Excel spreadsheet. The only column you will need is length so you can delete out the other columns by highlighting them and deleting them.
I. Open the following website in your web browser. This function will convert the lengths that you have recorded to approximate age of this particular windowpane flounder. Record the age in your Excel spreadsheet for each of the 33 fish.

Windowpane size→ age conversion:
http://www.nefsc.noaa.gov/cgi-bin/jhauser/conv/conv.pl

J. Select "Unknown" for location and make sure that your input length is in cm and

choose windowpane flounder as your species.

K. Once you click **submit** you will get your result that looks like the photo below. Record <1 year on your Excel sheet and precede to next fish until all fish are recorded.



Windowpane Flounder
Total Length = 19.0 cm
Weight = 0.19 pounds
Age under 1 year

L. To make your data distribution table for your results and for making the histogram it is easiest to **Sort** your data by highlighting the columns and **sorting by smallest to greatest.** This will make the summary table much easier to create.

Create the following categories and assign your fish to each category. If exactly 2.0 put in the larger category (ie 2.0-2.5 vs. 1.5-2.0). Your summary table should look something like this. There will be slight variation from student to student. Do make sure you have accounted for all fish by going to the bottom of your column and typing the command **=sum(highlight your #'s).** Make sure to use ( ) and then hit enter. This value should be **33. If not go back through and make sure all of your fish have been accounted for.**

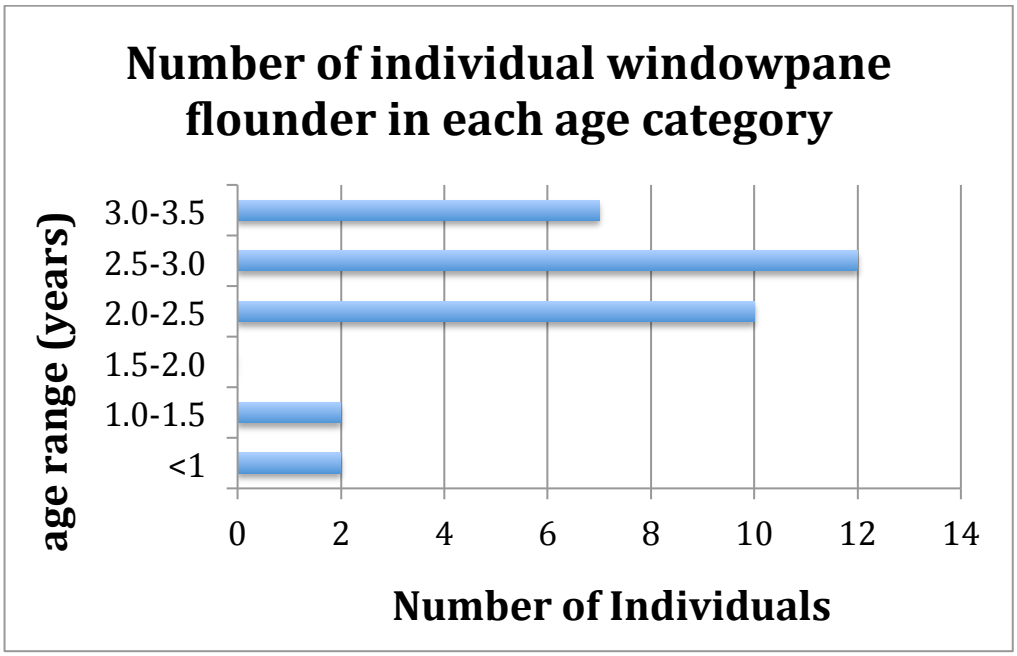
Age category	# of individuals
<1	2
1.0-1.5	2
1.5-2.0	0
2.0-2.5	10
2.5-3.0	12
3.0-3.5	7

M. Data will then be expressed in a histogram showing the number of fish in each age class.

N. Students will use the above table to draw their own histogram that will look like the Excel version below. They must label x and y-axis as well as give an appropriate title. This will be used to help answer questions on their worksheets.

O. Once students have finished their hand drawn Histogram. Highlight your data table and select **Insert->Chart**

P. Use a bar chart to display your data. Make sure to label the x and y axis with titles by going to **Chart→Chart Layout→ Axis titles**



Assessment and Evaluation:

Students will be asked to fill out the accompanying worksheet with questions and attach their graphs.

Standards:

National Science Education Standard(s) Addressed:

1. Unifying concepts and process in science
    a. Change, constancy and measurement
2. Science as inquiry
    a. Understating of scientific concepts
3. Science and technology
    a. Understating about science and technology
4. Science in personal and social perspective
    a. Types of resources
    b. Characteristics and changes in populations
    c. Changes in environments
    d. Natural resources

Ocean Literacy Principles Addressed:

Principle 6: The Ocean and humans are inextricably interconnected

6B. From the Ocean we get foods, medicines and mineral and energy resources.

In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security

National Science Standards:
Understanding Concepts and Processes (Systems Order and Organization) and Change consistency and measurement)
Earth and Science (Properties of Earth Materials)
Life Science (Diversity and adaptation of organisms)
History of Nature and science (Science as a human endeavor)
Personal and Social Perspectives (Personal health K-8, Types of resources, science and technology in society, personal and community health, population growth, natural resources, environmental quality, nature and human induced hazards, science and technology in local, national and global challenges.
Science as Inquiry (Understanding about scientific inquiry K-12)

6D. Much of the world's population lives in coastal area

National Science Standards
Understanding Concepts and Processes (Systems Order and Organization) and Change consistency and measurement)
History of Nature and science (Science as a human endeavor)
Personal and Social perspectives (characteristics and changes in populations, changes in environment, natural hazard)
Science as Inquiry (Understanding about scientific inquiry K-12)

6E. Humans affect the ocean in a variety of ways, Laws, regulations and resource management affect what is taking out and put into the ocean. Human development and activity lead to pollution and physical modification. In addition, humans have removed most of the large vertebrates from the ocean.

National Science Standards
Understanding Concepts and Processes (Systems Order and Organization) and Change consistency and measurement)
Life Science (organisms and environments, populations and ecosystems, interdependence of organisms)
Personal and Social perspectives (types of resources, changes in environments, science and technology in local challenges, populations, resources and environments, natural hazards, risk and benefits, science and technology in society, personal and community health, population growth, natural resources, environmental quality, nature and human induced health, science and technology in local, national and global challenges)
Science and technology (made by humans)
Science as Inquiry (Understanding about scientific inquiry K-12)

State Science Standard(s) Addressed:

New York State:

Standard 1: Analysis, Inquiry and Design

Key idea 2: Beyond the use of reasoning and consensus, scientific inquiry involves the testing of pro- posed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

Standard 2: Information systems

Key Idea 1: Information technology is used to retrieve, process, and communicate information as a tool to enhance learning.

Standard 4: The Living Environment

Key Idea 7: Human decisions and activities have had a profound impact on the physical and living environment.

Standard 6: Interconnectedness: Common Themes

Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.

Key Idea 2: Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.

Key Idea 3: The grouping of magnitudes of size, time, frequency, and pressures or other units of measurement into a series of relative order provides a useful way to deal with the immense range and the changes in scale that affect the behavior and design of systems.

Key Idea 5: Identifying patterns of change is necessary for making predictions about future behavior and conditions.

Key Idea 6:In order to arrive at the best solution that meets criteria within constraints, it is often necessary to make trade-offs.

Standard 7: Interdisciplinary Problem Solving

Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.

Key Idea 1: The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.

Key Idea 2: Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.

Other National or State Standards Addressed

National Math Standards
Numbers and operation
Measurement
Data analysis and probability
Connections
Representation

National Technology Standards
Communicate and collaborate
Conduct research and use information
Use technology effectively and productively

Additional Resources:

Feeding Ecology of Flatfish in the Northwest Atlantic
http://journal.nafo.int/j30/link.pdf

Atlantic Cod information
http://marinebio.org/species.asp?id=206#.ULkP0nPrQXw

Fishery of Windowpane flounder
http://www.nefsc.noaa.gov/sos/spsyn/fldrs/window/

Windowpane flounder facts
http://www.vims.edu/research/departments/fisheries/programs/multispecies_fisheries_research/species_data/windowpane_flounder/index.php

http://blueocean.org/documents/2012/03/flounder-windowpane-full-species-report.pdf

Possible Extensions to lesson:
Cod: A Biography of the Fish that Changed the World by Mark Kurlansky.
Will reinforce why scientists measure fish and how important looking at ages of fish is to monitoring stocks. Will also reinforce the difference between longer living higher trophic fish and shorter-lived species.

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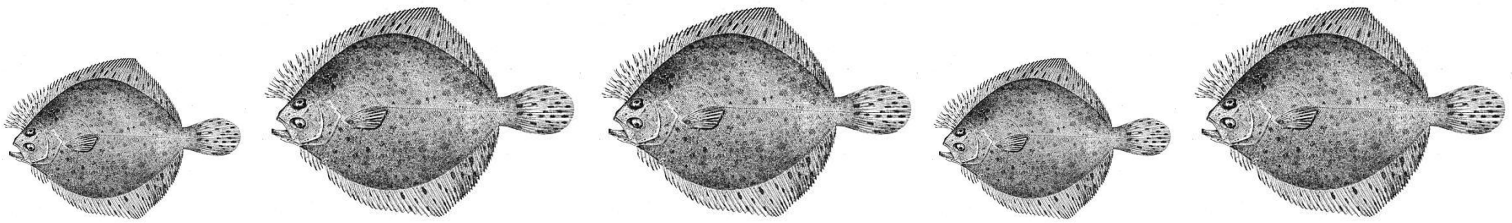


Becoming a Fisheries Biologist Worksheet

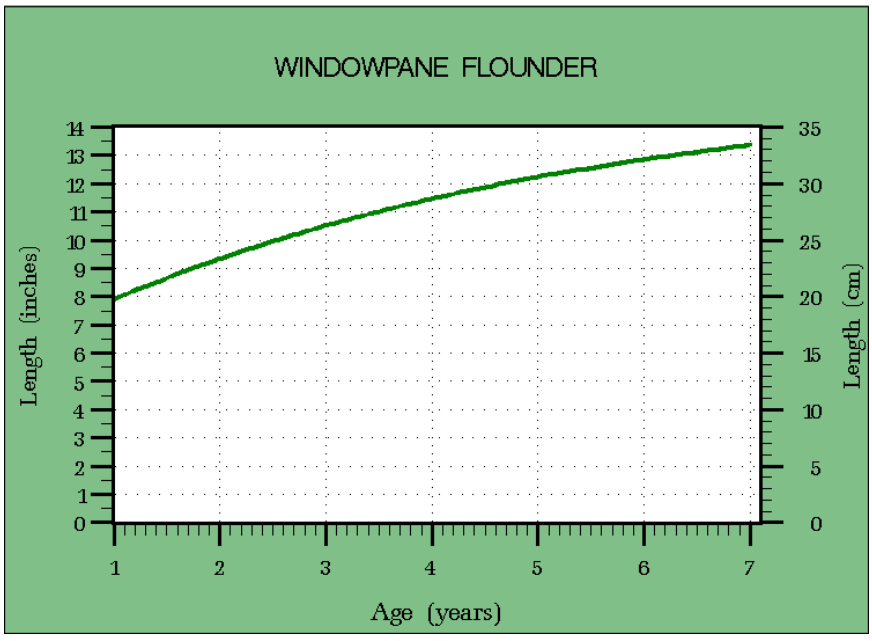
Note: Please staple your graph to this worksheet

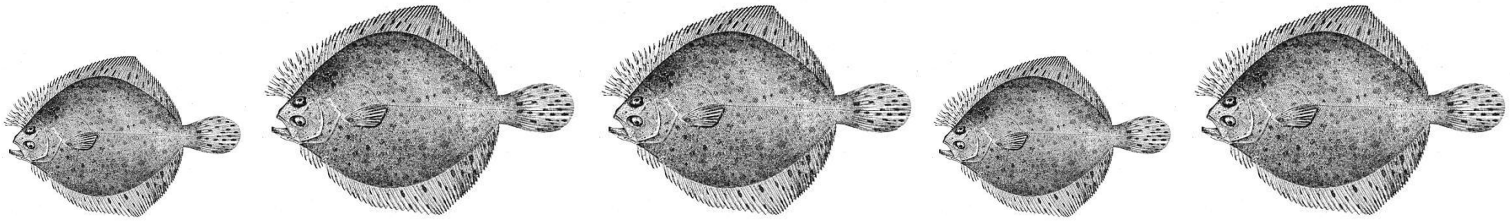
Name:_____

1. According to your histogram which age group has the most amount of individuals? The least?

2. What do you think this graph would look like in the spring of next year. These fish were measured in the fall.

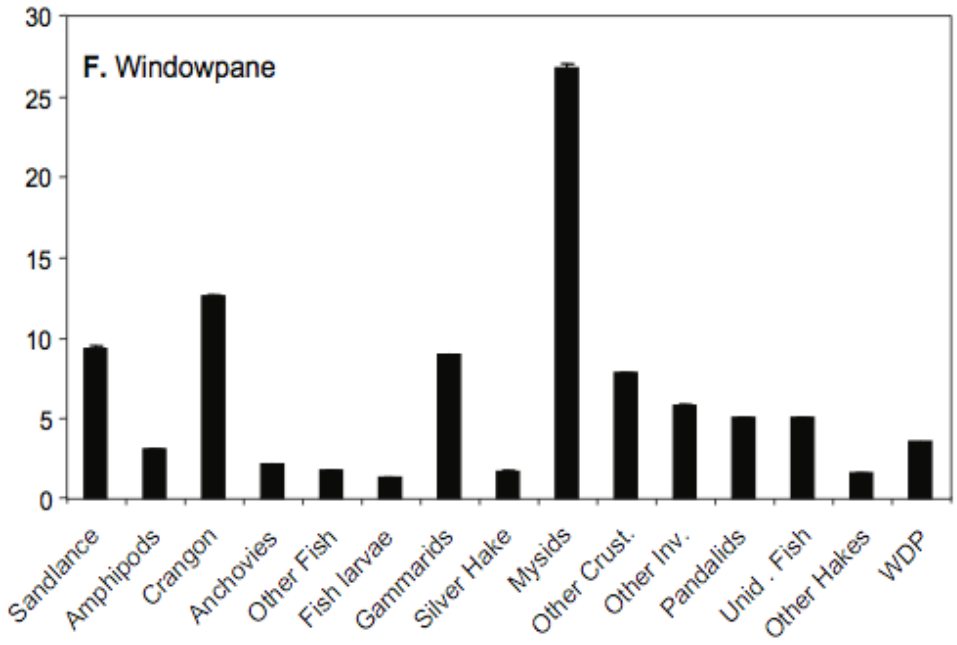
3. Below is the graph that was used to find how old our fish were based on the lengths we measured. How long would a fish have to be to be 6.5 years old? (Answer is approximate)?





4. The graph above was created using otoliths as an aging technique. What is an otolith?
5. What does makes up a majority of a windowpane flounders diet? What is it?

(Graph from Link et al. National Marine Fisheries Service)



6. Take a look back to the site where you converted a windowpane flounders length to age. Take your same measurements and change the species to Atlantic Cod? Do they grow slower or faster then windowpanes? What do Atlantic Cod eat? How long do they live?
   http://marinebio.org/species.asp?id=206#.ULkP0nPrQXw